STORAGE AND CATALOGING OF DRILL CORE BY THE BUREAU OF MINES

BY JAMES E. HILL

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SUMMARY

In the course of exploratory drilling during World War II by the Bureau of Mines under the Strategic and Critical Minerals Investigations Program, a problem arose as to the ultimate disposal of the drill core resulting from that program. The difficulties experienced in obtaining factual information to evaluate mineral deposits examined (during that program) influenced the Bureau in a decision to catalog and store the drill cores for future reference. Initially, the drill cores were stored at the nearest Bureau of Mines station that had space available for the purpose. Recently the Bureau stations at Minneapolis, Minn., and Denver, Colo., were designated as the locations of permanent drill-core storage facilities. Drill cores that are retained from Bureau of Mines mineral-exploration projects are stored at these two locations and are given preference in selecting cores for storage. Drill cores are accepted also for storage from other Government agencies, State agencies, private companies, or individuals on the basis of available facilities and consistent with the significance of the core in relation to Bureau of Mines objectives and national interest. Selection and acceptance of such drill core are determined by the Bureau of Mines. The drill cores stored at the two locations are available for inspection by any person having a legitimate interest in the mineral deposits represented by the cores.

Approximately 1,850,000 feet of drill core can be stored in the facilities now available to the Bureau of Mines. Approximately 475,000 feet of drill core is stored or scheduled for storage at Minneapolis, Minn., and 240,000 feet of core stored or scheduled for storage at Denver, Colo. A list of drill core now in storage at the Bureau of Mines core-storage facilities at Denver and Minneapolis is included as appendix A.

INTRODUCTION

An outgrowth of the exploratory drilling by the Bureau of Mines during World War II, under the Strategic and Critical Minerals Investigations program, was the decision to store and catalog drill core of possible future significant value. The decision was based on the mine-examination experience during this program, which showed a serious lack of reliable data from earlier exploration and development work that had been done on the mineral deposits examined. The experience of the Bureau of Mines was probably more marked than would be found in normal mine-examination work, because most of the deposits examined contained marginal or submarginal ore. It was the general experience that core from previous drilling was seldom available for study, and when logs of such drilling were available, they were frequently found to be incomplete or unreliable. This does not necessarily reflect on the effectiveness of such earlier work, but rather emphasizes the change in the economic importance of constituent minerals in a deposit and the changing economic conditions that influence classification of a mineral deposit as an ore body. The average recovered tenor of copper ores shown in table 1 for 1906-53, illustrates these changing conditions.

TABLE 1. - Average recovered tenor of ores[2]

Year	Copper (percent)	Year	Copper (percent)
1906	2.50	1931	1.50
1907	2.11	1932	1.83
1908	2.08	1933	2.11
1909	1.98	1934	1.92
		1935	1.89
1910	1.88		
1911	1.83	1936	1.54
1912	1.71	1937	1.29
1913	1.67	1938	1.34
1914	1.60	1939	1.25
1915	1.66	1940	1.20
1916	1.70	1941	1.15
1917	1.60	1942	1.09
1918	1.51	1943	1.04
1919	1.65	1944	.99
1920	1.63	1945	.93
1921	1.70	1946	.91
1922	1.74	1947	.90
1923	1.58	1948	.92
1924	1.59	1949	.91
1925	1.54	1950	.89
		1951	.90
1926	1.46	1952	.85
1927	1.41	1953	.85
1928	1.41		
1929	1.41		
1930	1.43		

The advantages of permanent storage and cataloging of drill cores were recognized by the President's Materials Policy Commission in a recommendation which states:[3]

> That the United States Geological Survey and the Bureau of Mines work out and submit to Congress a detailed program under which a coordinated national system of libraries of core samples, log data, and other geologic evidence can be established and maintained in cooperation with State Mining Agencies and the Mining Industry.

Other countries have also considered the importance of recording or saving drill cores. A report[4] on a United Nations questionnaire indicates that several countries have enacted legislation concerning the preservation of rock samples. Countries reporting such legislation include Austria, Denmark, Germany, Lebanon, Mexico, New Zealand, Panama, Spain, the United Kingdom, and Uruguay.

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[2] Compiled from figures in Bureau of Mines Minerals Yearbooks.

[3] U. S. President's Materials Policy Commission, Recommendation 2: Vol. 1, p. 29.

[4] South African Mining and Engineering Journal, New Wealth in Old Rocks: Vol. 64, No. 3169, Nov. 7, 1953, p. 343.

PURPOSE OF CORE STORAGE

The fact that the economic importance and value of a mineral deposit are subject to change imposes the requirement for periodic reevaluation. It is readily apparent that this purpose can best be served if actual physical samples of the deposit are available for study. Although it is customary for mining companies and individuals to file reports of mine examinations that include recorded data of work done, seldom is any systematic effort made to retain, for any great period, the drill core recovered during investigation of a mineral deposit. The drill core retained by mining companies is usually from deposits of more immediate commercial interest that are developed and mined at a relatively early date, after which the core is discarded.

The cost and the effort involved in drill core storage largely explain the fact that it is so often discarded within a short time. The immediate objective of a drilling program is served by the inspection and analysis of the drill core recovered, leaving little incentive for retaining the actual core. However, the immediate objectives of an exploration program may not be consistent with the criteria for evaluating a mineral deposit at some later date. The conditions and objectives at the time of an exploratory drilling project, with their influence on the thinking of personnel involved, may so direct and color the recorded data that it may have little value or even be misleading to later evaluation of the mineral deposit based on such data. Long-term changes in economic conditions and mineral use patterns are difficult to foresee to accurately judge the future value of a mineral deposit. Recurring emergency conditions in the world further distort projections into the future of the relative importance of a mineral deposit. The main purpose of drill-core storage is therefore to provide a permanent, tangible record of mineral exploration for further evaluation and study.

The cost of core storage is high when compared with the cost of filing written data describing the core. The disparity in cost must be justified by the advantages and value gained through having the actual drill core available for study. Experience in World War II indicated that the drilling program initiated because of the emergency could have been directed more efficiently, in many instances with a saving in money and effort, if drill core from previous investigations had been available for study as is now contemplated under the Bureau of Mines core-storage projects.

When it is considered that the cost of drilling for core falls in a general range of $2.00 to $12.00 a foot, the core now in storage represents a large financial investment in mineral investigations. The value of the core cannot, of course, be based on the cost of drilling or does it imply that equal expenditure would be required to establish or confirm the results of the drilling if the core has been destroyed. It does indicate the amount of money involved and opens to question the adequacy of drill logs and assays as the only data to be retained from these large investigative expenditures. Another factor in the Bureau's decision to establish core libraries was the element of public interest. It was recognized that other agencies and individuals, public and private, might wish to inspect the cores. As the Bureau's cores are, in a sense, public property it was felt that, if practicable, the cores should be made available for inspection to anyone who might wish to see them. The drill cores are regarded, in a way, as a public record. Essentially, the Bureau's drilling was confined to marginal mineral deposits that would have commercial interest only at a future date or in time of national emergency. It would be of decided advantage when a deposit became of possible commercial value if drill core were available for public inspection and study.

Acquisitions of drill core from private companies who may wish to make public the physical evidence from their exploration projects are welcome. Drill core from private exploration projects that are of direct interest to the Bureau's program for conservation and development of domestic mineral resources can, if necessary, be accepted on a confidential basis, and such core will not be available for public inspection without a release from the company. The responsibility of arranging for transportation of drill core from private exploration projects to the core-storage library must be assumed by the company.

The storage of drill core offers several important advantages that are not available when written drill logs and assays are the only record of the exploratory drilling of a mineral deposit. The drill core provides:

1. A check sample against the original log and analyses.
2. A sample that can be examined and analyzed for new or different materials not sought in the original investigation.
3. A material log of formations that may be examined for geologic evidence, such as horizon markers, that may not have been noted in original examination.
4. Material factual evidence to substantiate or refute differences of opinion that commonly arise in interpreting written drill logs.
5. A guide to ground and drilling conditions that will improve the efficiency of future drilling ventures on a particular deposit.
6. Specimens for inspection or physical testing to evaluate possible mining conditions and future mine development.
7. Samples for examination and tests to determine possible mineral beneficiation methods.

A common device to reduce the expense and effort of saving and storing drill core is the practice of skeletonizing the core; that is, selecting and retaining only relatively short lengths believed to be representative of longer continuous sections of the drill core. Skeletonizing has considerable merit, but its value depends on the skill and present judgment of the person making the selection. This is frequently found to be far from satisfactory. The full advantages of core storage can be realized only if the complete drill core is available.

During the early stages of the Bureau of Mines core-storage program, it was attempted to skeletonize core before storage. It was soon demonstrated that this practice was not satisfactory when inquiries were received concerning sections of drill core that had been discarded. The general method now practiced by the Bureau of Mines is to save the entire drill core when practicable or to save the entire drill core from one or more holes most representative of the deposit or particular area and skeletonize the drill core from the remaining holes.

HISTORY

In the 10 years from 1939 to 1949 the Bureau of Mines, as part of the Strategic Minerals Development Program, drilled 5,150 diamond-drill holes with a total linear extent of over 1 million feet.[5] The greater part of this work was done before and during World War II. During that period there was little opportunity to provide for the ultimate disposal of the drill core recovered by the diamond drilling. Much of it was abandoned or destroyed, and the rest was placed in whatever temporary storage was available.

When the pressure of work generated by the war decreased (in 1945), it was decided to provide for the storage of Bureau of Mines drill core. The first of such storage facilities or, as they are frequently called, "core libraries" was provided in 1945 at the Bureau of Mines Mount Weather Experimental mine, near Bluemont, Va. An unused drift in the mine was slabbed out, and racks were erected to make an underground core storage room.[6] Between 1947 and 1950 the immediate need for core-storage facilities was met by using available space at the nearest Bureau of Mines station. At that time drill cores were stored at Bluemont, Va.; Bauxite, Ark.; Rolla, Mo.; Minneapolis, Minn.; Denver, Colo.; Salt Lake City, Utah; Tucson, Ariz.; Reno, Nev.; Albany, Oreg., and Juneau, Alaska. The best drill-core storage facilities for a long-range core-library program were those at the Minneapolis and Denver Stations. In 1954 the Bureau of Mines began gradual consolidation of all core storage at these two stations except the cores stored at Bauxite, Ark., and Juneau, Alaska. The cores at these two locations were primarily of local interest, and it was felt that moving them to a central storage facility was not warranted. A list of the drill cores now in storage at the Bureau of Mines core-storage facilities at Denver and Minneapolis is included as appendix A.

FACILITIES

The Bureau of Mines plans to maintain two permanent core libraries, one at Minneapolis, Minn. and the other at Denver, Colo. In general, drill core originating in the East and South, will be shipped to Minneapolis for storage, and core originating in the West will be stored at Denver.

Minneapolis, Minn.

The core-storage facilities at Minneapolis are on Bureau of Mines land within the boundaries of the Government Military Reservation at Fort Snelling. A 60- by 200-foot fireproof structure with steel frame, aluminum siding and concrete-slab floor was erected to house the drill core (fig. 1). The building will accommodate 44 metal storage racks. Each rack is 5 feet wide, 23 feet long, and 7 feet high. Two racks are placed together to form a storage section 10 feet wide, with 6-foot aisles between each section (fig. 2). A partitioned room that can be heated provides space for inspection of cores stored in the library and workroom necessary for maintenance of the storage facilities. The capacity of this installation is approximately 1,500,000 feet of drill core.

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[5] Moon, Lowell B., Bureau of Mines Strategic Minerals Development Program: Bureau of Mines Rept. of Investigations 4647, 1950, 62 pp.

[6] Hill, James E., Diamond Drill-Core Storage at Mount Weather Test. Adit: Bureau of Mines Inf. Circ. 7394, 1947, 3 pp.

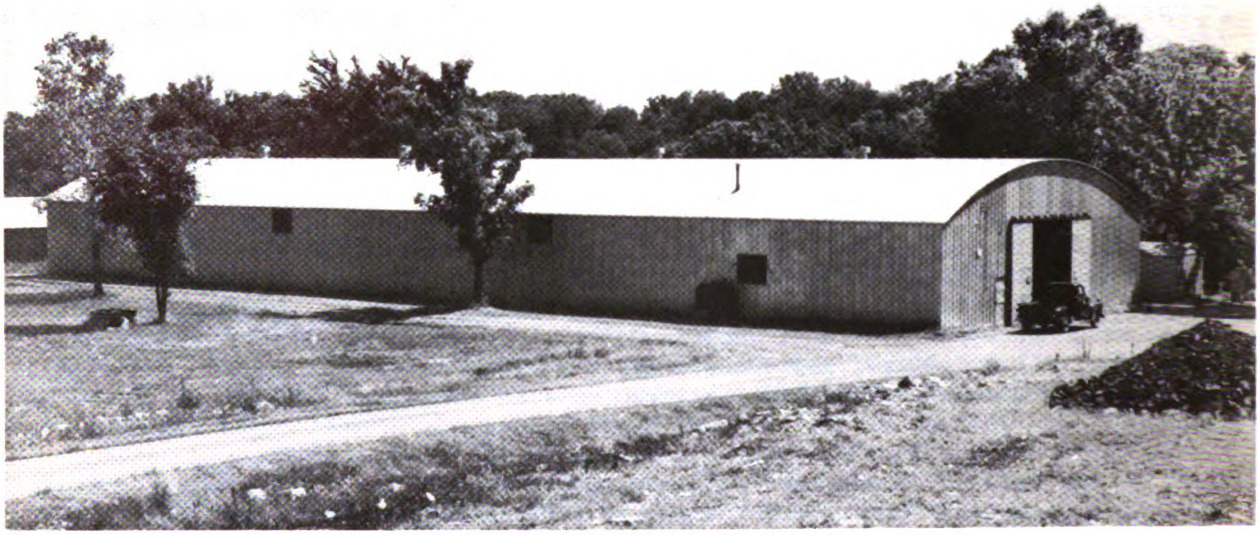

Figure 1. - Core-storage building, Minneapolis, Minn.

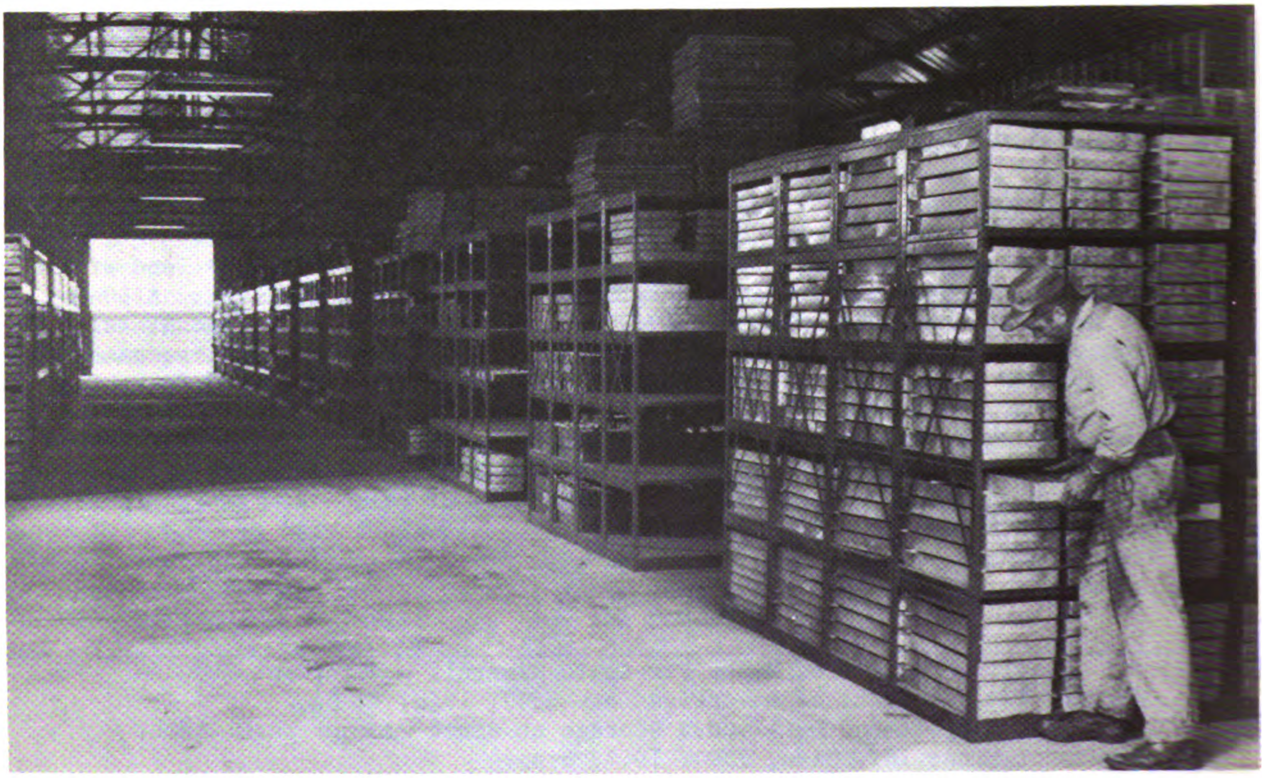

Figure 2. - Interior view, core-storage building, Minneapolis, Minn.

Denver, Colo.

The Public Buildings Administration provided core-storage facilities at the Denver Federal Center for joint use by the Bureau of Mines and the Geological Survey. The building is a corrugated iron and wood-truss structure, 265 feet long and 60 feet wide, with a space in the middle section 161 feet long designated for core storage. Half of the storage area is reserved by the Federal Geological Survey and is used by it for core storage. At the front of the building a 62-foot section is used by the Bureau of Mines for storage of equipment and a heated 26- by 30-foot annex is available for work on the core in cold weather (fig. 3). Concrete slabs 20 feet wide have been placed along each side of the building; upon these are erected the steel storage racks. The center aisle of the building is paved with asphalt.

Core-storage racks are constructed of angle iron and bolted to the concrete floor with cross bracing on each end and in three places in the center of the racks (fig. 4). Each side of the storage area will accommodate 9 double and 1 single rack section with a 6-foot service aisle between the sections. The double racks are 10 feet wide and consist of 7 vertical and 14 horizontal units. Each unit will hold 5 boxes of AX core or 4 boxes of BX or NX core. The estimated average storage capacity available for joint use by the Bureau of Mines and the Geological Survey is 700,000 feet of core. The actual capacity for any one size of core is 18,600 AX core boxes (837,000 feet of AX core), 15,200 BX core boxes (456,000 feet of BX core), or 14,900 NX core boxes (372,000 feet of NX core).

SELECTION OF CORE AND METHOD OF OPERATION

The two designated core-storage libraries were established to serve the Nationwide activities of the Bureau of Mines, but direct operation of each facility is under the jurisdiction of the respective Regional Office. The methods and procedures employed at the two storage facilities have been influenced by local conditions and vary somewhat but follow a general scheme of operation.

The primary purpose of the core-storage program is to retain and catalog the core drilled by the Bureau of Mines in the course of its mineral investigations. Processing of Bureau core takes precedence over handling of drill core from outside sources, and to date most of the activity has been concerned with this phase of the program. Drill core recovered during an exploratory drilling project is examined and logged at the drill site. The core is transported in temporary boxes to the core-storage library, where it is reboxed, if necessary, in permanent core trays and filed in the storage racks. Each core tray is marked for reference. Project reports, complete with maps of the location of drill holes, drill logs, assays, and progress of the project, are on file in the Technical Records File at College Park, Md., for all core stored from Bureau of Mines drilling projects. Bureau of Mines reports of investigations have been published on most of the drilling projects, presenting the data obtained by the investigations.

It is the intention and desire of the Bureau of Mines that its core-storage libraries be used by other Federal agencies, State agencies and institutions, private institutions, mining companies, and individuals having a legitimate interest in this activity. This is based on the belief that the value of core libraries, like the more conventional libraries, depends on the volume, selectivity, and circulation of its contents.

There are two phases to outside participation in the Bureau of Mines core-storage libraries: (1) Scientific study of the core that is in storage and (2)

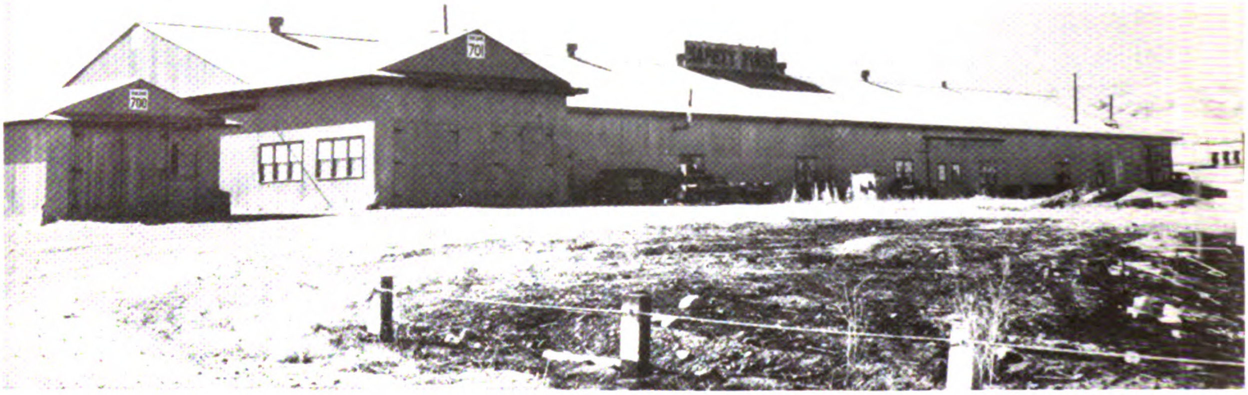

Figure 3. - Core-storage building, Federal Center, Denver, Colo.

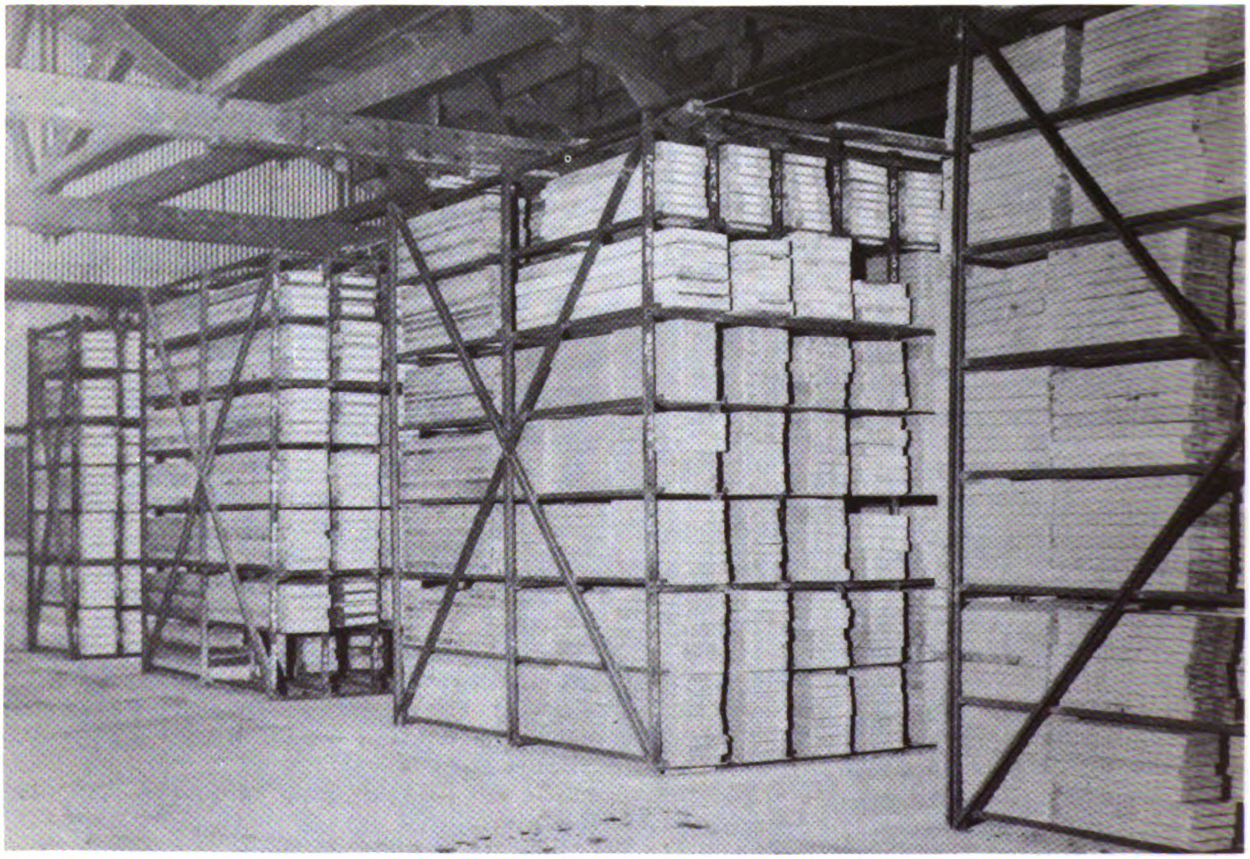

Figure 4. - Core-storage racks, Denver, Colo.

provision of facilities to store and catalog drill core from outside sources. The second phase is subject to the facilities available for that purpose. It is apparent that, while the ultimate purpose of the program would be served by storing all drill core, this is impractical because of the cost and space requirements, and a degree of selectivity must be imposed. The actual selection rests with the regional engineers who are familiar with local conditions and in the best position to exercise judicious selection. However, certain criteria may be listed in the order of their precedence as the basis for selection of drill core for storage, bearing in mind that the critical and strategic value of the mineral itself also is a consideration in the selection. These priorities are:

1. Bureau of Mines drilling projects.

2. Government sponsored drilling projects in which the Bureau of Mines has a direct interest.

3. Private mineral exploration projects that are of direct interest to the Bureau of Mines objective of conservation and development of domestic mineral resources.

4. Structural and wildcat mineral exploration in new or untested areas.

5. Private drill core from developed or abandoned mines.

Drill core received from outside sources should be accompanied by location maps of drill holes, drill logs, assays, and other reports helpful in the interpretation of the data represented by the core. The reports are filed and indexed to the core to establish a complete library record. Drill core from outside sources can be received on a confidential basis, in which case it is so marked and is not available for public inspection without the consent of the owner.

It is conceivable that with the passing of time and buildup in the volume of drill core in storage, some stored core may prove to be of insignificant value. Periodic evaluation of the catalog will be made, and when drill core is judged to be of no real value it will be discarded and the proper persons notified before such action is taken if notification is necessary.

CATALOGING AND STORING

The method of cataloging and storing drill core differs at the Minneapolis Station and the Denver Station, but each appears to serve its purpose equally well, hence is being continued. The method used at each station was selected as best suited for the purpose within the area from which drill core would originate. Both systems are adaptable to accept and consolidate drill cores now stored at other locations but scheduled for transfer to the two permanent core-storage facilities.

Minneapolis, Minn.

Storage space is divided into sections and designated by the name of a State. The division is so arranged that those States in which a large volume of core is drilled are allotted several steel storage racks, while several States in which little drilling is done may be allotted a single storage rack.

When drill core is received it is cataloged and indexed. An identification tag is placed on each core box. If core is received in boxes suitable for storage, they

Original from THE OHIO STATE UNIVERSITY

are tagged and placed in the storage racks. Core received in containers not suitable for storage is reboxed in metal boxes 12 inches wide by 30 inches long. The boxes are then tagged and placed in storage. A typical core-box identification tag with interpretation of the symbols would be:

Serial number	Red dot for confidential	Box number	Letters of mine
1	0	1 of 10	G L mine

GL-10	0 - 20'	Zinc	Wis.
Hole number	Drilling interval	Commodity	State

On the upper left corner of the identification tag is a serial number. The number is stamped on metal boxes or stamped on a separate metal tag, which is nailed to wooden boxes. The serial numbers run in sequence, and a separate series is used for each State. The serial number is useful to crossindex cores in storage. If the drill core is not available for public inspection, a red dot is painted to the right of the serial number, indicating that the core is confidential. The box number is designated, for example, "1 of 10," meaning that 1 interval of the core is stored in the first of 10 boxes. The upper right corner of the identification tag has an abbreviation of the mine name or property. In the example "GL mine," would indicate Good Luck mine. In the lower left corner below the serial number the hole number is designated as GL - 10 for hole number 10 from the Good Luck Mining Co. project. To the right of the hole number, and below the box number, is the drilling interval. The example 0 - 20' indicates that the first 20 feet of hole GL - 10 is stored in the box. The predominant commodity sought by the drilling or type of core and the State of origin are indicated in the lower right corner.

When the core box is marked with an identification, similar information, plus greater detail concerning the origin of the drill core, is entered on a core-storage record list as shown in the sample (fig. 5). Copies of this record are filed at the core library and the Bureau of Mines office in Minneapolis. Core ownership is noted on the back of each pertinent record sheet. From these data index cards are prepared and filed. The basic index is by States, crossindexed under each State by location and name of property and owner. Sample index cards are shown in figure 5.

The Minneapolis core-storage library has approximately 370,000 feet of drill core in storage. In addition to the drill core listed in appendix A as being stored at Minneapolis, there is a small quantity of core and cuttings resulting from sampling of a Canadian exploration project, churn-drill cuttings from the Wisconsin lead district, and drill cuttings from structural drilling on the Lake Superior ranges.

CORE-STORAGE RECORD-BOX LIST

State Minnesota

Box No.	Rack No.	Hole No.	Identification	Data File No.	Atlas		Sec.	Twp.	Range	County	Footage Interval
					Sec. Ref.	Serial					
747	1	7	Core Cuyuna Atlas	4	682	97	22	47N	29W	Crow Wing	165 - 203
748	1	7	Sludges - Cuyuna Atlas	4	682	97	22	47N	29W	Crow Wing	150 - 195
749	1	7	Sludges	4	682	97	22	47N	29W	Crow Wing	195 - 203
750	1	8	Cuyuna - Reverse (Also called USBM Exper.1)	4	682	98	22	47N	29W	Crow Wing	134 - 148
751	1	8	Cuyuna "	4	682	98	22	47N	29W	Crow Wing	148 - 162
752	1	8	" "	4	682	98	22	47N	29W	Crow Wing	162 - 176
753	1	8	" "	4	682	98	22	47N	29W	Crow Wing	176 - 198
754	1	8	" "	4	682	98	22	47N	29W	Crow Wing	198 - 220
755	1	8	" "	4	682	98	22	47N	29W	Crow Wing	220 - 231
			(SAMPLE)								

Accumulative Footage __________ Box __________

INDEX CARDS

Sec. 3 T. 47N R. 26W State Minnesota County Aitkin (3)
Sec. Ref. 946

INT.-BU.OF MINES,PGH.,PA. 6553

Box No.	Rack No.	Hole No.	Ser. No.	Data File	Description
494-496	1	D.H.250 256,260 265,270	68, 70 72		Rice River (Hanna)
497	1	D.H.281	62		" " "
1626-1628	2	1-Y - 3-Y	21-23		Crosby Exp.

S A M P L E

Name Bolton, Henry State Minnesota
County Koochiching, Morrison

INT.-BU.OF MINES,PGH.,PA. 6553

Box Nos.	Rack No.	No. of Holes	Data File	Sec.	T	R	Sec. Ref.
524	1	1		2	151	30	
525	1	1		3	151	30	
526-528	1	2		21	131	30	

S A M P L E

Figure 5. - Core-storage record list and index cards, Minneapolis, Minn.

Denver, Colo.

Drill core is stored in sequence as received. A numbering system on the storage racks provides an index to the location of the stored drill core. The method of numbering the storage racks consists of a three-unit combination number and letter system. The first unit designates the number of the rack, the second unit designates by a letter the horizontal row in a rack, and the third unit designates the vertical row or section number. For example, 4B2 would indicate that a core box was in rack 4, horizontal row B (second from the top), and vertical section 2.

Five to ten core boxes are stored in each identified storage unit of a rack. The number of boxes depends on the size of the core and the type of container in which it is stored. Each core box is marked with the project name and number or name of mine, hole number, and footage interval drilled.

Record cards are prepared on all the drill core in storage. These cards are filed alphabetically by the name of the project or mine, and provide an index of the stored core. Space on the card is provided to note the name of the mine or project, project number, hole number, box number, number of feet of core, storage location, owner's name, location from which the core was drilled, and a space for remarks.

COSTS

Approximate costs of storing core were obtained during the earlier phases of the program. The facilities provided for storage and the methods employed varied between the several locations that were initially used as storage sites. Therefore, costs are not directly comparable but do indicate a range of relative costs directly applicable to core storage. The percentage of the different sizes of core in storage also affects the total cost, as there is a considerable range between the cost per foot for storing EX (7/8-inch) core and for NX (3-inch) core.

The average cost of storage for all the core-storage facilities in use during 1953, based on total capacity filled with BX core, was 0.232 cent per foot of core. Table 2 is a breakdown of core-storage costs at the various Bureau of Mines core-storage facilities operated in 1953. Table 3 shows a breakdown of costs at the Mount Weather Experiment Station, Bluemont, Va., that indicates the variation in costs for different sizes of core. A recent cost analysis (1956) at Minneapolis shows the following costs: Storage space, $0.024; storage racks, $0.008; core boxes, $0.117; storing, $0.021; and an average cost per foot, BX size, $0.170.

The stated cost figures are for the initial cost of providing storage facilities, receiving, boxing and placing core in storage. The continuing cost of maintaining the core in storage has not been determined but is a small fraction of the initial cost.

TABLE 2. - Initial costs of core storage, based on an average BX size

	Albany, Oreg.	Reno, Nev.	Salt Lake City, Utah	Denver, Colo.	Tucson, Ariz.	Minneapolis, Minn.	Bauxite, Ark.	Rolla, Mo.	Mount Weather, Va.
Storage space....	$0.08	$0.18	-	-	$0.076	$0.024	$0.045	$0.076	$0.086
Storage racks....	.05	.05	$0.045	$0.062	-	.018	.035	.030	.005
Core boxes.......	.13	.05	.197	.104	.038	.186	.073	.043	.086
Storing (transfer to boxes, label, record, place in racks, etc.)....	1/ .15	-	.022	.089	-	.021	.013	.010	.021
Average cost per foot, BX size...	.41	.28	2/ .264	2/ .255	.104	.249	.166	.159	.198

1/ Includes pickup and transportation to warehouse.
2/ Does not include cost of storage space.

TABLE 3. - Influence of size of core on initial storage cost

	EX	AX	BX	NX
Mount Weather - per foot of core sample				
1. Excavation in mine	$0.055	$0.067	$0.086	$0.12
2. Wooden trays (material, labor, and wood treatment)	.055	.067	.086	.12
3. Racks (for trays in mine, material and erection)	.003	.004	.005	.007
4. Transfer core from field boxes to storage trays, labeling core and trays, storing in mine	.013	.016	.021	.03
Total	.126	.154	.198	.277

CONCLUSIONS

The requirement for inventory and appraisal of mineral raw materials in the United States is stressed by the continued depletion of known "economic" mineral deposits and the growing complexity of the industrial structure. The likelihood of chance discoveries of significant mineral deposits is decreasing. Scientific methods of exploration must be applied if the domestic supply of mineral resources is to be maintained. A scientific study of stored drill core can be of value in two distinct approaches to this problem. It may provide information regarding low-grade deposits amenable to economic development through application of technological advances in mining and metallurgy, and it may be used as subsurface geological data to guide exploration for new ore deposits at depth, or buried extensions of known ore zones.

Industrial and military advances in technology have created new use patterns for many minerals. Stored core, available for scientific study, is invaluable for appraisal of known deposits for new and often unexpected minerals. This was demonstrated by the sudden importance of radioactive minerals. Drill core in the Bureau of Mines core libraries was scanned with a Geiger counter to determine areas of possible interest as sources of radioactive minerals.

APPENDIX A. - Drill core stored by the Bureau of Mines[1]

Mine, property, or project	County	Commodity	No. of holes	Footage
ALABAMA				
Alabama red iron	Etowa and St. Clair	Iron	6	5,378
Coosa tin	Coosa	Tin	5	283
Emauhee mine	Talladega	Iron	1	487
Fort Wayne Coking coal	DeKalb and Cherokee	Coal	2	1,064
Gray Hematite ores - Heacock Mountain	Talladega	Iron	1	548
Great Southern mica mine	Randolph	Mica	1	98
Haynes mica mine	Randolph	do.	1	112
Hurst mica mine	Clay	do.	1	131
Kid mica-mica beryl	Tallapoosa	Mica-beryl	1	157
Liberty mica mine	Randolph	Mica	1	119
Pyriton mine	Clay	Pyrite	4	1,488
Red iron ore	Bibb	Iron	11	3,956
Riser Mountain	Talladega	do.	1	599
J. J. Smith No. 1 mica	Clay	Mica	1	83
Tallaseehatchee area	Talladega	Iron	1	344
ARIZONA				
Amargosa	Pima	Molybdenum-copper	3	1,453
Antler copper-zinc	Mohave	Copper-zinc	6	2,130
Apache	Navajo	Iron	15	1,170
Artillery Peak	Mohave	Manganese	69	3,600
Cerbat	do.	Lead-zinc	8	2,475
Christmas	Gila	Copper	7	3,245
Civitation	Mohave	do.	7	3,394
Copper Giant	Pima	do.	2	1,409
Crown King	Yavapai	do.	3	1,438
Keystone	Cochise	do.	27	10,712
Lake Shore Copper	Pinal	do.	1	203
ARKANSAS				
Arkansas bauxite	Rulaski and Saline	Bauxite	53	883
Christy titania	Hot Springs	Titanium	1	82
Lecroy property	Garland	Test	4	11
Magnet Cove rutile	Hot Springs	Titanium	27	3,047
Reeves Hill manganese	Independence	Manganese	6	272

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[1] The stored drill core is listed alphabetically by mine or project name under each State. Unless otherwise noted, the drill core from the Western States is stored or scheduled for storage at Denver, Colo. Core from other areas is stored or scheduled for storage at Minneapolis, Minn.

Mine, property, or project	County	Commodity	No. of holes	Footage
CALIFORNIA				
Abbott quicksilver mine	Lake	Mercury	6	644
Akoz mine	Mariposa	Copper	3	72
Atolia tungsten	San Bernardino	Tungsten	8	1,252
Bessemer copper	do.	Copper	12	465
Bully Hill mine	Shasta	do.	6	85
Carbonate King zinc	San Bernardino	Lead-zinc	8	1,909
Copper Bluff mine	Humboldt	Copper	4	225
Keystone asbestos	Siskiyou	Asbestos	5	349
Minarets iron deposit	Madera	Iron	2	72
Mohawk mine	San Bernardino	Copper	10	49
New Almaden quicksilver	Santa Clara	Mercury	10	120
New Penn mines	Calaveras	Lead-zinc	10	4,771
Quien Sabe antimony	San Benito	Antimony	10	333
Rush Creek lead-zinc	Mono	Lead-zinc	5	687
Strawberry tungsten	Madera	Tungsten	8	458
Trinity asbestos	Trinity	Asbestos	5	212
Tulare County tungsten	Tulare	Tungsten	10	1,508
Walabu Mining Co.	Kern	do.	7	1,727
COLORADO				
Aspen	Pitkin	Lead-zinc	3	495
Big Four	Summit	do.	10	1,615
Brown Derby	Gunnison	Mica-beryl	7	1,840
Camp Bird	Ouray	Lead-zinc	7	3,948
Copper Hill mine	LaPlata	Copper	5	490
Crystal Mount Pegmatite	Larimer	Mica-beryl	4	296
Dunmore	Ouray	Lead-zinc	10	983
Empire Min. and Eng. Co.	Boulder	Fluorspar	4	1,077
Fairview Hill	Lake	Manganese	5	628
Gateway Min. & Devel. Co.	Mesa	Uranium	27	1,372
Golden Cycle	Montrose	Copper	2	336
Jamestown	Boulder	Fluorspar	13	4,363
Leadville Lead & Dauntless Tunnel	Park	Lead-zinc	5	1,057
Leadville Tunnel	Lake	do.	3	736
Lucky Strike	Summit	do.	4	658
Lupton Grizzly	Clear Creek	do.	6	385
Madonna	Chaffee	do.	18	4,186
Madonna Utze Lode Co.	do.	do.	9	1,526
Lode Co.	do.	do.	12	1,737
Michigan	Summit	do.	1	306
Midnight	Pitkin	do.	9	1,635
New Anniversary Bucky	Gunnison	Mica-beryl	2	225
Rare Earth	do.	Rare earths	10	802
Realty Co.	Gilpin	-	3	232
Ross Basin	San Juan	Lead-zinc	39	10,265
Shelby-Johnson	Park	do.	7	733
Snowbank	Summit	do.	3	309
Eula Belle	Montrose	Uranium	7	797
Wilfley	Summit	Lead-zinc	30	11,480

Mine, property, or project	County	Commodity	No. of holes	Footage
CONNECTICUT				
Strickland Cramer Mine	Middlesex	Mica	1	249
GEORGIA				
Chestatee pyrite mine	Lumpkin	Copper-pyrite	7	1,119
Georgia beryl and mica-Amphlett mine	Cherokee	Mica-beryl	2	147
Georgia coal-Lookout Mountain	Walker and Dade	Coal	2	198
Georgia mica spots-Mitchell Creek	Upson	Mica	1	120
Louise chromite	Troup	Chrome	4	542
Tallapoosa pyrite-Tallapoosa, Ga.	Haralson	Copper-pyrite	2	782
IDAHO				
Cougar	Shoshone	Lead-zinc	5	3,752
Hermada antimony	Elmore	Antimony	8	1,600
Highland Surprise	Shoshone	Lead-zinc	19	4,431
Hornsilver	Blaine	do.	3	1,110
Ima mine	Lemhi	Tungsten	3	1,358
Nabob silver	Shoshone	Lead-zinc	3	1,593
National	do.	do.	7	1,793
North Fork Mining Co.	do.	do.	2	682
Pope-Shenon	Lemhi	Copper	19	4,023
Rhode Island	Shoshone	Lead-zinc	5	2,841
Sidney mine	do.	do.	16	5,912
Signal mine	do.	do.	5	893
Sunset minerals	do.	do.	5	2,593
Wonder mine	Lemhi	do.	3	962
ILLINOIS				
Bautsch mine	Jo Daviess	do.	5	1,167
Blewett zinc-lead	do.	do.	12	2,031
Gray Bautsch mine	do.	do.	1	405
Gray mine	do.	do.	1	185
Interstate fluorspar	Hardin	Fluorspar	3	1,492
Knox fluorspar	do.	do.	4	2,662
Mougin mine	Jo Daviess	Lead-zinc	1	859
Royal Princess zinc-lead	do.	do.	6	272
IOWA				
Iowa coal-Albert L. Davis	Marion	Coal	2	302
Iowa coal-Loren Davis	do.	do.	1	99
NW. States Portland Cement Co.	Cerro Gordo	Limestone	1	667

Mine, property, or project	County	Commodity	No. of holes	Footage
KENTUCKY				
Fluorspar	Crittenden	Fluorspar	2	511
Kentucky fluorspar	Caldwell	do.	6	1,983
K. T. Dome	Henry	do.	4	1,640
MAINE				
Aroostook Mountain-Bridgewater	Aroostook	Manganese	68	28,051
Burnham, Hammond Twp.	do.	do.	1	294
Bumpus Quarry-Bethel	Oxford	Beryl	7	1,084
Cape Rosier, Maine	Hancock	Copper	1	221
Cape Rosier, Maine - (Harborside)	do.	do.	4	2,952
Douglas mine, Blue Hill	do.	do.	7	1,991
Hercules-Cape Rosier	do.	do.	11	5,007
Pierce-Hammond Twp.-Houlton-So. Aroostook Mountain	Aroostook	Manganese	6	754
Tapley mine-Hancock	Hancock	Copper	5	1,119
MARYLAND				
Camp Ritchie	Washington	Structure	24	2,520
Woodstock quarry, diamond-bit test	Baltimore	Experimental	15	328
MICHIGAN				
A. Kraus	Delta	Iron	3	2,806
Anarson property	Iron	do.	2	80
Barassa Devel. Co.	Marquette	do.	2	292
Barnett	Iron	do.	4	834
Crosby Exp. Co.	Dickson	do.	31	2,984
Hanna Co., Cannon mine	Iron	do.	1	71
Hanna Co., Hiawatha mine	do.	do.	26	4,600
Hanna Co., Hiawatha mine No. 2	do.	do.	1	751
Hanna Hia.	do.	do.	32	4,196
Hanna Hia. Duff	do.	do.	25	3,359
Hanna Hia. Stegmiller	do.	do.	28	5,814
Hanna West Hia.	do.	do.	8	972
Hanna West West Hia.	do.	do.	1	91
Homer mine	do.	do.	41	6,603
Minckler mine	do.	do.	8	1,152
Wauseca mine	do.	do.	34	4,693
Wico Exp.-Wakefield mine	Gogebic	do.	53	35,871

Mine, property, or project	County	Commodity	No. of holes	Footage
MINNESOTA				
Adams property	Lake	Iron	3	677
Aitkin-Magoffin property	Aitkin	do.	12	1,882
Carlton County Exam.	Carlton	do.	5	1,383
C. J. O'Connell	Aitkin	do.	1	219
Crosby exp.	Crow Wing	do.	641	60,925
Do.	Aitkin	do.	28	1,631
Cuyuna Atlas	Crow Wing	do.	9	1,754
Cuyuna Devel.	Aitkin	do.	7	1,454
Great Northern properties	do.	do.	22	2,614
Do.	Crow Wing	do.	19	2,051
Henry Bolton	Koochiching	do.	2	59
Do.	Morrison	do.	2	66
Kerr-Kerr, North American Iron Co.	Cook	do.	15	1,663
Olson & Berg Exp. Co.	Aitkin	do.	1	55
Park E. Simmons	St. Louis	do.	6	1,407
Rice River (Hanna)	Aitkin	do.	122	3,580
MISSOURI				
American Metal Co., Ltd.	Washington, Iron, and Crawford	do.	74	28,260
Bourbon magnetic anomaly	Crawford	do.	2	2,662
Krueger zinc	Washington	Lead-zinc	19	3,680
Ozark Ore Co.				
Pilot Knob	Iron	Iron	9	3,150
Iron Mountain	St. Francois	do.	222	48,150
Rex zinc mine	Howell	Lead-zinc	1	60
MONTANA				
Benbow-Mouat	Stillwater	Chrome	6	1,801
Black Pine	Granite	Tungsten	16	3,530
Durand (Wasa)	do.	Lead-zinc	13	4,909
Miller mine	do.	do.	1	247
Mouat Nickel	Stillwater	Nickel	8	5,377
Norwich mine	Silver Bow	Manganese	5	1,744
Phillipsburg	Granite	do.	16	6,494
Revais Creek copper	Sanders	Copper	2	423
Shamrock	Jefferson	do.	3	1,142
Sunrise-Golden Eagle	Granite	do.	8	1,670

Mine, property, or project	County	Commodity	No. of holes	Footage
NEVADA				
Argentine zinc-lead mine	Clark	Lead-zinc	12	192
Baxter fluorspar deposit	Mineral	Fluorspar	7	3,270
Buena Vista iron	Churchill	Iron	3	271
Comet Coalition lead-zinc mine	Lincoln	Lead-zinc	3	103
Copper Canyon lead-zinc deposit	Lander	Copper	18	1,743
Dayton iron property	Lyon and Storey	Iron	12	11
Gibellini manganese	Eureka	Manganese	6	433
Green talc mine and Bismark mine	Mineral	Talc	12	1,342
McArthur copper	Lyon	Copper	8	1,249
Mt. Hope mine	Eureka	Lead-zinc	18	4,445
Phelps-Stokes iron deposit	Nye	Iron	3	15
Poinsettia mercury	Mineral	Mercury	6	281
Rio Grande Copper Co.	Elko	Copper	2	724
Segerstrom-Heiser mine	Pershing	Iron	8	45
Stormy Day mine	do.	Tungsten	7	107
Table Mountain copper	Churchill	Copper	13	830
Union Zinc-lead mine	Washoe	Lead-zinc	21	438
Ward mine	White Pine	do.	2	140
Yellow Pine mine	Clark	Copper	7	49
NEW HAMPSHIRE				
Blister mine	Cheshire	Mica	1	49
Big Mica mine	do.	do.	1	50
Milan mine	Coos	Copper	7	3,095
Ore Hill mine	Grafton	do.	2	398
Stoddard mine	Cheshire	Mica	1	244
NEW JERSEY				
Hackettstown area magnetite				
West Portal, N. J.	Hunterdon	Iron	1	362
Cummins mine	Warren	do.	7	2,617
Hoit mine	do.	do.	5	857
Ayers mine	do.	do.	3	627
Henry tunnel	do.	do.	1	225
Mount Olive	Morris	do.	1	168
Sulphur Hill mine				
Andover, N. J.	Sussex	Copper	3	1,526

Mine, property, or project	County	Commodity	No. of holes	Footage
NEW MEXICO				
Bellahs Lead King copper prospect	Hidalgo	Copper	1	317
Cash Entry lead-zinc mine	Santa Fe	Lead-zinc	2	891
Copper Flat	Grant	do.	5	5,979
Harding pegmatite	Taos	Mica-beryl	8	1,483
Leach	Hidalgo	Lead-zinc	2	257
Peerless	Grant	do.	2	2,423
Rio Grande	Luna	Fluorspar	5	1,399
Royal John	Grant	Lead-zinc	11	1,937
Silver spot	do.	do.	1	633
Steeple Rock	do.	do.	14	4,357
Swartz district	Grant and Sierra	do.	18	3,949
Torpedo copper	Dona Ana	Copper	4	2,097
West Pinos Altos	Grant	Lead-zinc	6	1,823
White Eagle	do.	Fluorspar	3	1,021
NEW YORK				
Clifton Magnetite DeGrasse, N. Y.	St. Lawrence	Iron	206	38,965
Guymard mine	Orange	Lead-zinc	4	1,846
Hyatt-Loomis, Gouverneur	St. Lawrence	do.	3	2,484
Lead-zinc	do.	do.	18	3,800
Lyon Mount area-Earl anomaly	Clinton	Iron	1	371
Lyon Mount area-Signor Works (Redford, N.Y.)	do.	do.	2	1,062
Parish magnetite	St. Lawrence	do.	25	7,906
Shawangunk mine, Wurtsboro, N.Y.	Sullivan	Lead-zinc	3	1,702
Star Lake-Brunner Hill	St. Lawrence	Iron	1	329
Star Lake-Deerlick Rapids	do.	do.	2	817
Star Lake-outafit	do.	do.	2	840
Star Lake-Skate Creek	do.	do.	6	1,675
Star Lake-Spruce Mtn.	do.	do.	9	3,943
Sterling Lake (Red Back)	Orange	do.	1	420
Summitville lead-zinc	Sullivan	Lead-zinc	25	6,522
NORTH CAROLINA				
Big Ore Bank, Lincolnton, N.C.	Lincoln	Iron	2	645
Chambers mine	Wilkes	Copper	4	998
Cline mine	Cabarrus	Copper-tungsten	4	597
Cranberry mine	Avery	Iron	2	1,699
Davis chromite	Wake	Chrome	1	89
Deep River coal	Chatham	Coal	1	889

Mine, property, or project	County	Commodity	No. of holes	Footage
NORTH CAROLINA (Con.)				
Furniss mine	Cabarrus	Copper-tungsten	8	615
Furniss tungsten	do.	Tungsten	3	704
Magruder	Lincoln	Copper	6	2,182
Pegmatite mining and sampling	Gaston	Mica	8	1,172
Scarlet pyrite	Randolph	Copper-pyrite	2	427
Union copper	Cabarrus and Rowan	Copper	2	556
OREGON				
Evans Creek	Jackson	Tin	1	119
Queen of Bronze (Takilmo-Waldo)	Josephine	do.	4	321
Shamrock nickel	Jackson	Nickel	11	3,420
PENNSYLVANIA				
Albright Farm	Blair	Lead-zinc	3	683
Almedia lead	Columbia	do.	4	1,111
Bamford mine	Lancaster	do.	4	953
Boyertown mine, Defense Plant Corp.	Berks	Iron	2	1,767
Central spot iron, Dillsburg, Pa.	York	do.	8	2,399
High-alumina clay, Central, Pa.	Clinton	Alumina	13	3,179
New Galena	Bucks	Lead-zinc	2	349
Perkiomen copper, Oaks, Pa.	do.	Copper	5	2,167
Pickering Creek, Phoenixville, Pa.	Chester	Lead-zinc	8	2,322
SOUTH CAROLINA				
Brewer mine	Chesterfield	Topaz	14	2,439
Sillimanite, S.C.	Spartanburg	Sillimanite	4	188
SOUTH DAKOTA				
*Big Chief	Pennington	Beryl	2	240
Edison mine	do.	Lithium	11	1,267
*Expectation	do.	Test	1	110
*Ferguson	do.	do.	2	265
*Galena	Lawrence	Lead-zinc	2	980
Hot Shot mine	Custer	Mica	3	547
Jack Rabbit mine	do.	do.	2	223
Mateen mine	Pennington	Lithium	8	1,166
*Michaud	Custer	Beryl	3	331
Midas mine	do.	Mica	2	207
*Mount Lion	do.	Soda spar	1	300

*South Dakota core marked by an asterisk is stored at Denver. South Dakota core not marked is stored at Minneapolis.

Mine, property, or project	County	Commodity	No. of holes	Footage
SOUTH DAKOTA (Con.)				
Peerless mine	Pennington	Mica	7	1,506
Rainbow mine	Custer	do.	3	185
Silver Dollar mine	do.	do.	1	38
Victory mine	do.	do.	2	305
White Bear mine	do.	do.	3	595
TENNESSEE				
Chamberlain Barnardsville	Roane	Iron	2	362
Chattanooga shale	Union	Structure	37	1,278
Eve's Mill	Monroe	Lead-zinc	1	302
Melton	Union	do.	1	88
Moccasin Gap	Cocke	Barite	2	375
Powell River zinc	Monroe	Lead-zinc	2	791
Stiner	Union	do.	1	173
UTAH				
Brown Queen group	Millard	Tungsten	2	550
Brush beryllium	Tooele	Mica-beryl	36	3,600
Drum Mountain	Juab	Manganese	6	1,902
Dry Canyon lead-zinc	Tooele	Lead-zinc	6	2,553
Eagle silver deposit	do.	do.	8	575
Harrington-Hickory	Beaver	do.	10	2,127
Midstate Development	Millard	-	31	1,808
New Park Mining	Wasatch	Lead-zinc	3	705
Piute Blackbird manganese	Piute	Manganese	8	358
Thompson magnesium	Grand	Magnesium	1	854
Treasure Hill	Tooele	Lead-zinc	31	4,579
Vicksburg	Beaver	do.	7	2,544
VERMONT				
Ely mine	Orange	Copper	4	4,882
VIRGINIA				
Amelia pegmatite, Amelia, Va.	Amelia	Mica	43	1,288
Bush-Hutchins ilmenite, Roanoke, Va.	Roanoke	Titanium	3	570
Gossan lead-Betty Baker mine	Carroll	Copper	8	1,866
Gossan lead-Lineberry mine	do.	do.	18	3,466
Mecklenburg tungsten	Mecklenburg	Tungsten	10	1,005
Mineral Virginia-Virginia pyrite	Louisa	Pyrite	1	391

Mine, property, or project	County	Commodity	No. of holes	Footage
VIRGINIA (Con.)				
Mount Weather	Loudon	Structure	1	100
Oriskony iron ore	Craig, Botetourt, Alleghany, Bath	Iron	20	1,206
Timberville, Va.	Rockingham	Lead-zinc	4	1,019
Willis Mount kyanite	Buckingham	Kyanite	32	3,590
WASHINGTON				
American zinc	Pend Oreille	Lead-zinc	6	5,399
Anderson	Stevens	do.	16	1,187
Blue Bird	Pend Oreille	do.	13	5,209
Blue Ridge	Stevens	do.	5	Not reported
Bonanza	do.	do.	2	876
Buckhorn	Okanogan	Iron	7	2,877
Cle Elum	Kittitas	Nickel	4	2,743
Farmer	Stevens	Lead-zinc	2	522
Fortune Creek	Chelan	Tungsten	3	725
Gorien zinc	Stevens	Lead-zinc	9	1,367
Granore Co.	Snohomish	Copper	196	10,942
G.S. spot drilling Centralia and Chehalis districts	Lewis	Coal	35	16,414
St. Regis	Clallam	Manganese	10	2,725
Sierra zinc	Stevens	Lead-zinc		
Sunset copper	Snohomish	Copper	14	3,746
Sunset mine (Index)	do.	do.	129	5,571
Tacoma clay	King	Clay	11	1,752
Wine Sap nickel	Chelan	Nickel	7	1,016
Yakima City	Yakima	Copper	13	Not reported
Young America	Stevens	Lead-zinc	15	4,598
WEST VIRGINIA				
West Virginia iron - Dan mine	Greenbrier	Iron	1	80
West Virginia iron ore	Pocahontas and Greenbrier	do.	9	507
West Virginia iron - Perry mine	Greenbrier	do.	1	80
WISCONSIN				
Boren property	Oconto	do.	4	330
Crosby Expl.	Jackson	do.	8	1,029
Crosby Expl. - Black River Falls	do.	do.	26	4,334
Crosby Expl. - Phillips	Price	do.	15	47
Fairplay lead-zinc	Grant	Lead-zinc	15	2,225
Hord-Rahm mine	Florence	do.	1	306
M. C. mine	Lafayette	do.	3	292

Mine, property, or project	County	Commodity	No. of holes	Footage
WISCONSIN (Con.)				
Nigger Jim	Lafayette	Lead-zinc	2	130
Rodham mine	do.	do.	6	1,062
Wausau zircon	Marathon	Zircon	30	365
Weyerhouser property	Douglas	Copper	2	185
WYOMING				
Bull Lake sodium sulfate deposit	Carbon	Sodium sulfate	8	341
Continental Sulphur & Phosphate Co.	Park	Sulfur	4	126
Copper King	Laramie	Copper	8	4,910
Encampment vermiculite	Carbon	Vermiculite	6	926
Iron Mountain	Albany	Iron	3	622
Lander phosphate	Fremont	Phosphate	10	1,310
Rambler mine	Albany	Copper	8	1,204
Shanton	do.	Titanium	3	658